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MEMORANDUM

TO: Howard Burge, USFWS

FROM: Michele DeHart

DATE: July 31, 2006

RE: Update to 'Low spring Chinook rack returns at Dworshak Hatchery relative to Rapid River Hatchery'

In response to your request, we extended our analysis on associations between juvenile outmigration history and upstream-migrating adult conversion rates (Bonneville Dam to Lower Granite Dam) for Dworshak (DWORNF) and Rapid River (RAPH) hatcheries. We used precisely the same methods as used in our earlier memo. The resulting contingency tables appear on the following pages.

Consistent with what we found in our across-years regression analysis (in previous memo), upstream migration success also varied in relation to juvenile outmigration history when each year was examined individually using χ^2-tests. Specifically, adults that emigrated as in-river smolts consistently made a successful upstream spawning migration at a higher-than-expected rate; those that were transported as juveniles made the upstream passage at a lower-than-expected rate. This was true for DWORNF salmon in 4 of the last 5 years (2002-4, 2006) and RAPH salmon for 3 of the last 5 years (2002-3, 2005). Though slightly stronger for DWORNF than RAPH Chinook (e.g., contrasting LGR-transport group conversion success between hatcheries) on average (**Tables 1-5; Figure 1**), the magnitude of a transportation effect was variable across years. Also worth noting, it appears that the disparity in conversion rates between transported and in-river groups is less pronounced for adults that were transported downstream collection sites (i.e., Little Goose, Lower Monumental, and McNary dams).

Considering these findings and those summarized in our previous memo, it appears that transportation effects at least partially account for differences between DWORNF and RAPH rack returns in 2006 and other years. However, additional analyses may be necessary to fully account for differences across years. For instance, variation in Zone 6 harvest rates in return years and/or hatchery release practices during out-migration years may also play an important role in observed between-hatchery differences.

Table 1. Contingency table (count-by-category, row percents in parentheses) of successful/failed upstream migration (i.e., detected subsequently at LGR) of adult salmon detected at BON as a function of juvenile transport history (LGR = transported from LGR; LGSdown = at LGS, LMN, or MCN) for the **2002 return year** for DWORNF and RAPH salmon. χ^2-test results indicate that there is a significant association between conversion success and outmigration history for RAPH ($P < 0.001$) DWORNF ($P = 0.052$, marginally significant) Chinook salmon.

Hatchery	Out-migration history	Successful	Failed
DWORNF	In-river	86 (71%)	35 (29%)
	$\text{Transported}_{\text{LGR}}$	60 (58%)	44 (42%)
	$\text{Transported}_{\text{LGSdown}}$	33 (56%)	26 (44%)
RAPH	In-river	135 (77%)	40 (23%)
	$\text{Transported}_{\text{LGR}}$	154 (63%)	89 (37%)
	$\text{Transported}_{\text{LGSdown}}$	94 (82%)	20 (18%)

Table 2. Contingency table for the **2003 return year**. χ^2-test results indicate that there is a significant association between conversion success and outmigration history for RAPH ($P = 0.002$) and DWORNF ($P = 0.003$) Chinook salmon.

Hatchery	Out-migration history	Successful	Failed
DWORNF	In-river	123 (81%)	28 (19%)
	$\text{Transported}_{\text{LGR}}$	64 (63%)	37 (37%)
	$\text{Transported}_{\text{LGSdown}}$	52 (80%)	13 (20%)
RAPH	In-river	251 (86%)	42 (14%)
	$\text{Transported}_{\text{LGR}}$	270 (75%)	91 (25%)
	$\text{Transported}_{\text{LGSdown}}$	88 (78%)	25 (22%)

Table 3. Contingency table for the **2004 return year**. χ^2-test results indicate that there is a significant association between migration success and outmigration history for DWORNF ($P = 0.002$), but not RAPH ($P = 0.319$) Chinook salmon.

Hatchery	Out-migration history	Successful	Failed
DWORNF	In-river	164 (87%)	24 (13%)
	$\text{Transported}_{\text{LGR}}$	22 (65%)	12 (35%)
	$\text{Transported}_{\text{LGSdown}}$	33 (73%)	12 (27%)
RAPH	In-river	751 (83%)	150 (17%)
	$\text{Transported}_{\text{LGR}}$	81 (81%)	19 (19%)
	$\text{Transported}_{\text{LGSdown}}$	73 (89%)	9 (11%)

Table 4. Contingency table for the **2005 return year** for DWORNF and RAPH salmon. χ^2-test results indicate that there was not a strong association between conversion success and outmigration history for either RAPH (P = 0.078) DWORNF (P = 0.471) Chinook salmon.

Hatchery	Out-migration history	Successful	Failed
DWORNF	In-river	43 (80%)	11 (20%)
	$\text{Transported}_{\text{LGR}}$	17 (71%)	7 (29%)
	$\text{Transported}_{\text{LGSdown}}$	12 (67%)	6 (33%)
RAPH	In-river	156 (82%)	34 (18%)
	$\text{Transported}_{\text{LGR}}$	147 (76%)	47 (24%)
	$\text{Transported}_{\text{LGSdown}}$	62 (87%)	9 (13%)

Table 5. Contingency table (count-by-category) for the **2006 return year** for DWORNF and RAPH salmon. χ^2-test results indicate that there is a significant association between migration success and outmigration history for DWORNF (P = 0.001), but not RAPH (P = 0.104) Chinook salmon.

Hatchery	Out-migration history	Successful	Failed
DWORNF	In-river	44 (67%)	22 (33%)
	$\text{Transported}_{\text{LGR}}$	16 (34%)	31 (66%)
	$\text{Transported}_{\text{LGSdown}}$	31 (65%)	17 (35%)
RAPH	In-river	31 (91%)	3 (9%)
	$\text{Transported}_{\text{LGR}}$	51 (74%)	18 (26%)
	$\text{Transported}_{\text{LGSdown}}$	13 (72%)	5 (28%)

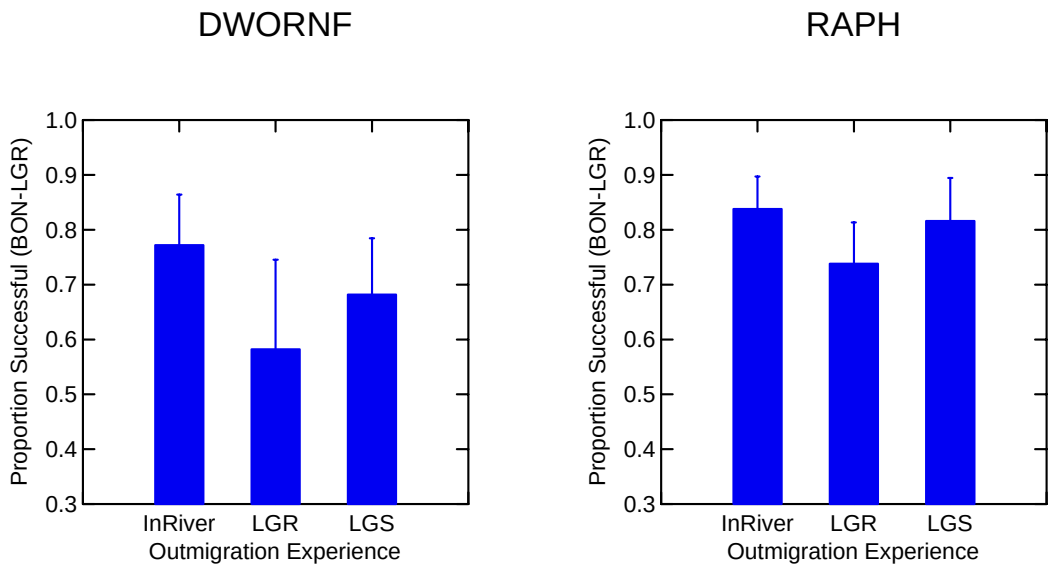

Figure 1. Barchart of mean (+/- 1 SD) proportion successful upstream adult migrants by juvenile outmigration experience (InRiver = in-river outmigrant; LGR = transported at Lower Granite; LGS = transported at Little Goose or another downstream collection site).